Lloyd's Register

Rules for the Manufacture, Testing and Certification of Materials, July 2008

Notice No. 3

Effective Date of Latest Amendments:

See page 1

Issue date: February 2009

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RULES FOR THE MANUFACTURE, TESTING AND CERTIFICATION OF MATERIALS, *July 2008*

Notice No. 3

This Notice contains amendments within the following Sections of the *Rules for the Manufacture, Testing and Certification of Materials, July 2008.* The amendments are effective on the dates shown:

Chapter	***Section***	***Effective date***
1	3	1 July 2009
2	1, 2, 3, 4, 7	1 July 2009
3	2	1 July 2009
4	8	1 July 2009
8	1	Corrigendum
11	2, 4, 5, 8	1 July 2009
13	2	1 July 2009

The *Rules for the Manufacture, Testing and Certification of Materials July 2008* are to be read in conjunction with this Notice No. 2. The status of the Rules is now:

Rules for Materials	Effective date:	July 2008
Notice No. 1	Effective date:	1 August 2008
Notice No. 2	Effective dates:	1 January 2009 & Corrigendum
Notice No. 3	Effective dates:	1 July 2009 & Corrigendum

Chapter 1

General Requirements

Effective date 1 July 2009

■ *Section 3*
Certification of materials

3.4 Electronic certification

3.4.2 In addition to the requirements of 3.4.1, for items certified under the Materials Survey Scheme, the LR office stamp and Surveyor's ~~signature~~ name may be applied electronically~~ by the Surveyor~~. This is only allowed where the Surveyor has access to the results of the relevant tests and inspections, and is able to authorise by access to the electronic system, the ~~production~~ application of the LR office stamp and Surveyor's name on the test certificate ~~with their signature~~. The name of the authorising Surveyor is to be the name included on the certificate. The authorisation may be conducted electronically either at the manufacturers' works, or remotely by the Surveyor.

3.4.3 If the ~~Surveyor's~~ LR office stamp and ~~signature~~ name are being applied electronically according to 3.4.2, then the manufacturer is to ensure that the Surveyor is provided with all relevant information regarding the customer order, when the request for authorisation is made.

Chapter 2

Testing Procedures for Metallic Materials

Effective date 1 July 2009

■ *Section 1*
General requirements for testing

1.2 Testing machines

1.2.1 All tests are to be carried out by competent personnel ~~on machines of approved types~~. ~~The~~ Testing machines are to be maintained in a satisfactory and accurate condition and are to be recalibrated at approximately annual intervals. This calibration is to be carried out by ~~a nationally recognized authority or other organization of standing and is~~ organisations of standing that have been approved or recognised by a National Authority and are to be to the satisfaction of the Surveyor. A record of all calibrations is to be kept available in the test house. ~~The accuracy of test machines is to be within ± one per cent.~~

1.2.2 Tensile testing machine load cells are to be calibrated with an accuracy of ± one per cent in accordance with ISO 7500-1 or another recognised National Standard.

1.2.3 Impact tests are to be carried out on Charpy V-notch machines calibrated to ISO 148, EN 10045 or ASTM E23 dependent on the testing machine type. The testing machines are to be calibrated using either a direct or indirect method. Other National Standards equivalent to ISO 148 may be considered.

1.4 Re-testing procedures

1.4.1 Where the result of any test, other than an impact test, does not comply with the requirements, two additional tests of the same type are to be made from the same test sample, or if sufficient material is not available, a further representative sample taken from the item under test. For acceptance of the material, satisfactory results are to be obtained from both of these additional tests.

1.4.2 Where the result of any test taken from a weld procedure approval test, other than an impact test, does not comply with the requirements, two additional tests of the same type are to be made from the same weld test assembly. Where insufficient original welded assembly is available, a new assembly is to be prepared using the same conditions as the original test weld. For acceptance, satisfactory results are to be obtained from both of these additional tests.

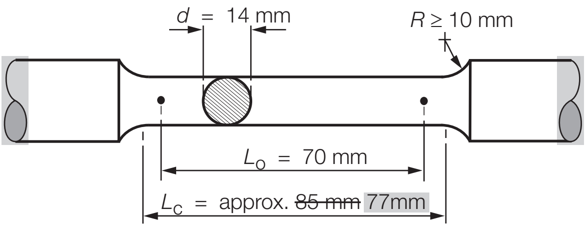
1.4.3 Where the result of any test taken from a welding consumable approval test, other than an impact test, does not comply with the requirements, two additional tests of the same type are to be made from the same weld test assembly. Where insufficient original welded assembly is available, a new assembly is to be prepared using welding consumables from the same batch. If the new assembly is made with the same procedure (particularly the same number of runs) as the original assembly, only the duplicate re-test specimens need be prepared and tested. For acceptance of a weld consumable batch, satisfactory results are to be obtained from both of these additional tests.

Existing paragraphs 1.4.2 *to* 1.4.7 *have been renumbered* 1.4.4 *to* 1.4.9.

■ *Section 2*
Tensile tests

2.1 Dimensions of test specimens

2.1.2 The gauge length is to be greater than 20 mm and may be rounded off to the nearest 5 mm provided that the difference between the adjusted gauge length and the calculated one is less than 10 per cent of the calculated gauge length.

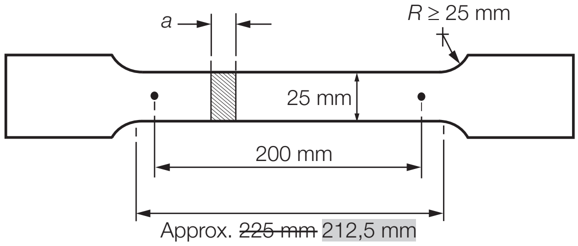


NOTE: For nodular cast iron and materials with a specified elongation less than 10%, $R \geq 20$ mm

Fig. 2.2.1
Test specimen dimensions for forgings and castings – I

Fig. 2.2.2
Test specimen dimensions for forgings and castings – II and aluminum alloys

Fig. 2.2.3
Test specimen dimensions for plates, strip and sections – I and aluminum alloys



a = thickness of material

Fig. 2.2.4
Test specimen dimensions for plates, strip and sections – II

~~*2.1.11* The dimensions of test specimens from weldments and the procedures for testing them are given in Ch 11,2.~~

2.1.11 For aluminium alloy plates and sections of thickness, *a*, less than or equal to 12,5 mm; the dimensions of rectangular cross sectioned test specimens are to be as shown in Fig. 2.2.3. The rectangular cross sectioned test specimen surfaces should remain as rolled/extruded. Where the thickness, *a*, is greater that 12,5 mm the test specimens are to be or round type as shown in Fig. 2.2.2.

2.1.12 Deposited weld metal tensile test specimens are to be machined to the dimensions shown in Fig. 2.2.9, and may be heated to a temperature not exceeding 250°C for a period not exceeding 16 hours for hydrogen removal, prior to testing.

2.1.13 Butt weld tensile test specimens are to be machined to the dimensions shown in Fig. 2.2.10. For thicknesses of more than 2 mm, the test width is to be 25 mm. For thicknesses less than 2 mm, the test width is to be reduced to 12 mm. The upper and lower surfaces of the weld are to be filed, ground or machined flush with the surface of the plate.

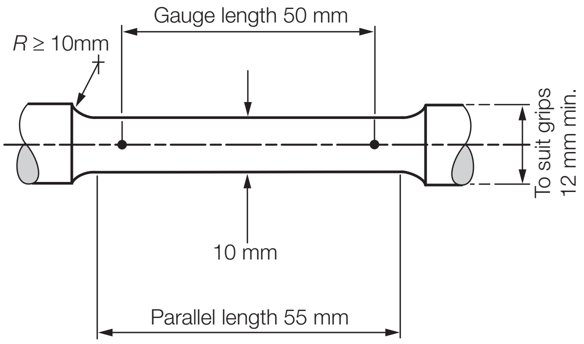


Fig. 2.2.9
Test specimen for deposited weld metal tensile

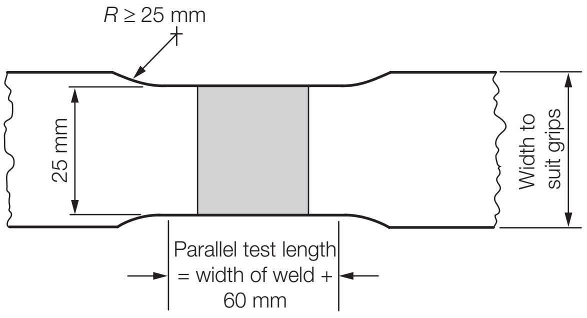


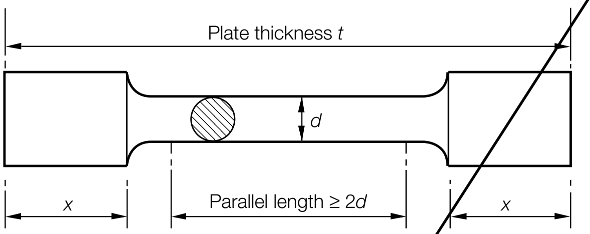
Fig. 2.2.10 Test specimen for butt weld

~~2.1.12~~ *2.1.14* Through-thickness tensile test specimens may be, at the option of the steelmaker, either plain test specimens~~, Fig. 2.2.9,~~ or test specimens with welded extensions~~, Fig. 2.2.10~~ in accordance with a Recognised Standard. ~~For both types of test specimens the diameter of the parallel portion is to be not less than:~~

~~6 mm where plate thickness ≤ 25 mm~~
~~10 mm where plate thickness > 25 mm~~

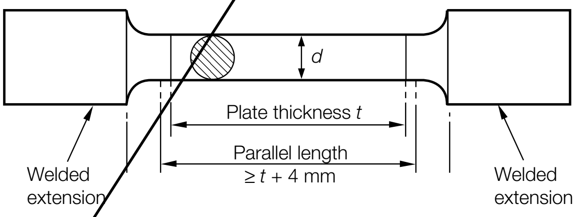
The extension pieces are to be of steel with a tensile strength exceeding that of the plate to be tested and may be attached to the plate surfaces by manual, resistance or friction welding carried out in such a way as to ensure a minimal heat affected zone.

~~2.1.13~~ *2.1.15* Tolerances on tensile specimen dimensions are to be in accordance with ~~ISO 6892-84 and ISO 185-88~~ ISO 6892-98 or another Recognised Standard as appropriate.



t = plate thickness, in mm
d = 6 mm minimum when $t \leq 25$ mm
d = 10 mm minimum when $t > 25$ mm
x = 5 mm maximum

Fig. 2.2.9 Plain test specimen



t = plate thickness, in mm
d = 6 mm minimum when $t \leq 25$ mm
d = 10 mm minimum when $t > 25$ mm

Fig. 2.2.10 Test specimen with welded extension

2.3 Procedure for testing at ambient temperature

2.3.1 Except as provided in 2.3.5, the elastic stress rate ~~is not to exceed 30 N/mm^2 per second~~ for the determination of the upper yield ~~or proof stress of steels~~ for steels and copper alloys is to be between 6 and 60 N/mm^2 per second and between 2 and 20 N/mm^2 per second for aluminium. ~~and is not to exceed 10 N/mm^2 per second in measuring the proof stress of other materials.~~ After reaching the yield or proof load, the straining rate may be increased to a maximum of 0,008s^{-1} ~~40 per cent of the gauge length per minute~~ for the determination of the tensile strength.

2.3.2 For steel, the upper yield stress is to be calculated from:

~~(a) the load immediately prior to a distinct drop in the testing machine lever; or~~
~~(b) the load immediately prior to a fall back in the movement of the pointer or the load at a marked hesitation of this pointer; or~~
~~(c) a load/extension diagram using the value of load measured either at the commencement of plastic deformation at yield or at the first peak obtained during yielding even when that peak is equal to or less than any subsequent peaks observed.~~
(a) the value of stress measured at the commencement of plastic deformation, or
(b) on a load/extension diagram using the value of stress measured at the first peak obtained during yielding even when the peak is equal to or less than any subsequent peaks observed during plastic deformation at yield.

2.3.3 When a well defined yield point cannot be obtained, the ~~0,5~~ 0,2 or 1,0 per cent proof stress ~~under load is to be calculated from the load corresponding to a total extension of 0,5 or 1,0 per cent of the original gauge length. This extension is to be measured either by the use of a suitable extensometer or by dividers.~~ (non-proportional elongation) is to be determined from an accurate load/extension diagram by drawing a line parallel to the straight elastic portion and a distance from it where the amount represents 0,2 or 1,0 per cent of the extensometer gauge length. The point of intersection of this line with the plastic portion of the diagram represents the proof load, from which the 0,2 or 1,0 per cent proof stress can be calculated.

2.3.4 ~~The 0,2 or 1,0 per cent proof stress (non-proportional elongation) is to be determined from an accurate load/extension diagram by drawing a line parallel to the straight elastic portion and distant from it an amount representing 0,2 or 1,0 per cent of the extensometer gauge length. The point of intersection of this line with the plastic portion of the diagram represents the proof load, from which the 0,2 or 1,0 per cent proof stress can be calculated.~~ For stainless steels the 1,0 per cent proof stress and/or 0,2 per cent proof stress is specified as required by the relevant Chapters in these Rules.

Section 3
Impact tests

3.2 Testing procedures

3.2.1 All impact tests are to be carried out on Charpy machines approved by Lloyd's Register (hereinafter referred as LR) ~~and, complying with the requirements of ISO 148 or other recognized International or National Standards~~ and having a striking energy of not less than 150 J. ~~The testing machines are to be calibrated annually using either a direct or indirect method.~~

3.2.3 For acceptance, the average energy value for a set of three impact tests must be equal to or greater than the appropriate specified minimum average value. Additionally, only one individual value may be less than the required average value but not less than 70 per cent of this average value.

Existing prargraphs 3.2.3 *and* 3.2.4 *have been renumbered* 3.2.4 *and* 3.2.5.

Section 4
Ductility tests for pipes and tubes

4.3 Drift expanding tests

4.3.2 For ~~steel~~ metallic tubes, the length of the specimen is to be at least 1,5 times the external diameter of the tube except when a mandrel with an included angle of 30° is used, in which case the length of the specimen is to be twice the external diameter of the tube. In all cases the length ~~is not to be less than 50 mm~~ of section remaining cylindrical after test is not be less than 0,5 times the external diameter.

~~*4.3.3*~~ ~~For copper and copper alloy tubes the length of the specimen is to be not less than twice and not more than three times the external diameter.~~

~~*4.3.4*~~ ~~For aluminium and light alloy tubes the length of the specimen is to be at least twice the external diameter.~~

~~*4.3.5*~~ *4.3.3* Testing is to be carried out at ambient temperature and is to consist of expanding the end of the tube symmetrically by means of a hardened conical steel mandrel having a total included angle of 30°, 45° or 60°, *see* Fig. 2.4.1. The mandrel is to be forced into the test specimen at a rate not exceeding 50 mm/min until the percentage increase in the outside diameter of the end of the test specimen is not less than the value given in the specific requirements for boiler and superheater tubes, *see* Chapter 6. The mandrel is to be lubricated, but there is to be no rotation of the tube or mandrel during the test. The expanded portion of the tube is to be free from cracks or other flaws.

4.4 Flanging tests

4.4.2 Testing is to be carried out at ambient temperature and is to consist of flanging the end of the tube symmetrically by means of hardened conical steel mandrels. The rate of flanging is not to exceed 50 mm/min.

Section 7
Bend tests

7.1 ~~Application and testing~~ Dimensions of test specimens

~~*7.1.1*~~ ~~Bend tests are mainly used in the testing of welds. The requirements are given in Ch 11,2.~~

7.1.1 Flat bend test specimens are to be of rectangular cross-section with dimensions as defined in Fig. 2.7.1.

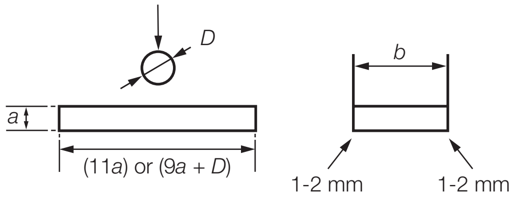


Fig. 2.7.1 Bend test specimen

7.1.2 For plates, sections and strip the dimensions shall be full thickness and width 30 mm. Where the rolled thickness exceeds 25 mm the compression face may be reduced to 25 mm.

7.1.3 For forgings, castings and semi-finished products the thickness shall be 20 mm and width 25 mm.

7.1.4 Butt weld face and root bend test specimens are to be 30 mm in width and of the full plate thickness. Where the thickness exceeds 25 mm, two side bend test specimens may be tested in place of the face and root specimens specified. The side bend specimens should be 10 mm minimum thickness. The upper and lower surfaces of the weld are to be filed, ground or machined flush with the surface of the plate.

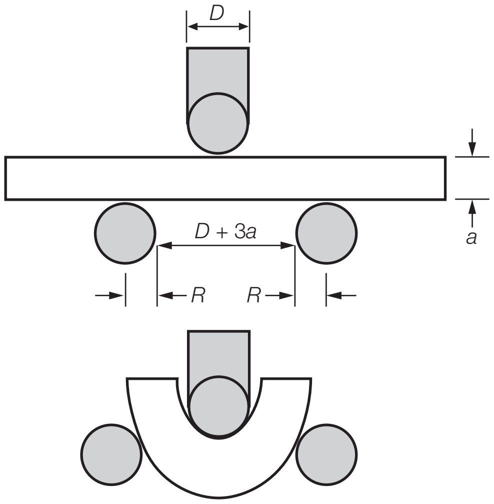
7.1.5 The edges on the tension side of bend samples are to be rounded to a radius of 1 to 2 mm.

7.2 Testing procedures

7.2.1 The bend sample is plastically deformed by plunging a mandrel between two fixed points as shown in Fig. 2.7.2.

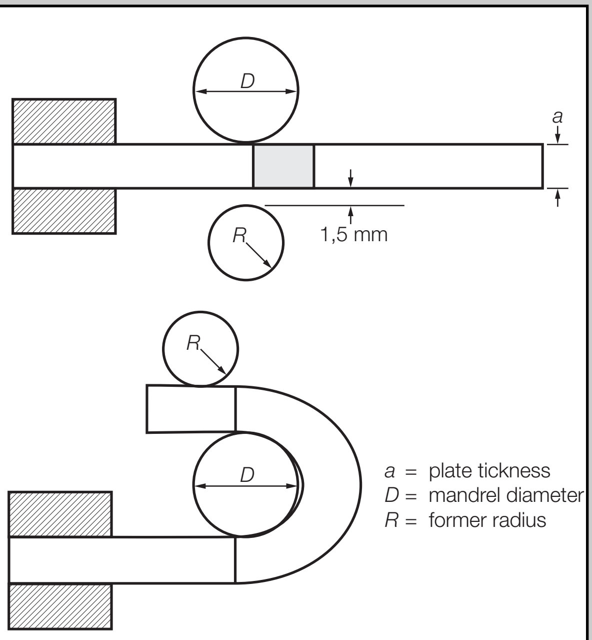
7.2.2 For aluminium welds a guided bend is required to ensure even deformation as shown in Fig. 2.7.3.

7.2.3 Bend tests are to be conducted at ambient temperature at the highest convenient rate of bending (but not impact).



a = thickness of bend sample
R = radius of roller
D = outside diameter of former

Fig. 2.7.2 Bend test



a = plate tickness
D = mandrel diameter
R = former radius

Fig. 2.7.3 Guide bend test for aluminium

Chapter 3

Rolled Steel Plates, Strip, Sections and Bars

Effective date 1 July 2009

■ *Section 2*
Normal strength steels for ship and other structural applications

2.4 Mechanical tests

2.4.6 When Grade A steel is supplied in a thickness greater than 50 mm and either, in the normalizing rolled condition, or when special approval has been given ~~for material thicker than 50 mm~~ to supply ~~be supplied~~ in the as-rolled condition, a set of three impact test specimens ~~are~~ is to be tested from each batch of 50 tonnes or fraction thereof.

Chapter 4

Steel Castings

Effective date 1 July 2009

■ Section 8

~~Austenitic stainless steel castings~~

Stainless steel castings

8.1 Scope

8.1.1 This Section gives the requirements for castings in austenitic and duplex stainless steels for machinery, marine structures, piping systems in ships for liquefied gases ~~where the design temperature is not lower than –165°C~~, and in bulk chemical tankers.

8.1.2 Austenitic stainless steels castings are suitable for applications where the lowest design temperature is not lower than –165°C.

8.1.3 Duplex stainless steels castings are suitable for applications where the lowest design temperature is above 0°C. Any requirement to use duplex stainless steels castings below 0°C will be subject to special consideration.

~~*8.1.2*~~ *8.1.4* Where it is proposed to use alternative steels, particulars of the specified chemical composition, mechanical properties and heat treatment are to be submitted for approval.

8.3 Heat treatment

8.3.1 ~~All~~ Austenitic stainless steel castings are to be solution treated at a temperature of not less than 1000°C and cooled rapidly in ~~air, oil or~~ water.

8.3.2 Duplex stainless steels castings are to be solution treated at a temperature of not less that 1100°C and cooled rapidly in water.

8.5 Intergranular corrosion tests

8.5.1 Where corrosive conditions are anticipated in service, intergranular corrosion tests are required on castings in grades 304, 316, 317 and ~~317~~ all duplex stainless steels. Such tests may not be required for grades 304L, 316L and 347.

Table 4.8.1 Chemical composition of ~~austenitic~~ stainless steel castings

Type of steel	Chemical composition %								
	C ~~max.~~	Si	Mn	S	P	Cr	Mo	Ni	Others
Austenitic									
304L	0,03	0,20-1,5	0,50-2,0	0,040 ~~max.~~		17,0-21,0	—	8,0–12,0	—
304	0,08						—	8,0–12,0	—
316L	0,03						2,0–3,0	9,0–13,0	—
316	0,08						2,0–3,0	9,0–13,0	—
317	0,08						3,0–4,0	9,0–12,0	—
347 (*see* Note 1)	0,06						—	9,0–12,0	Nb ≥ 8 x C ≤ 0,90
Duplex									
UNS S 31803	0,03	1,00	2,00	0,025	0,035	21,0–23,0	2,5–3,5	4,5–6,5	N 0,8–0,20

NOTES
1. When guaranteed impact values at low temperature are not required, the maximum carbon content may be 0,08% and the maximum niobium may be 1,00%.
2. Where a single value is shown (and not a range of values), the value is to be taken as maximum.

Table 4.8.2 Mechanical properties for acceptance purposes: ~~austenitic~~ stainless steel castings

Type of steel	Tensile strength N/mm^2 minimum	1,0% proof stress N/mm^2 minimum	Elongation on 5,65$\sqrt{S_o}$ % minimum	Reduction of area % minimum	Charpy V-notch impact tests	
					Test temperature °C	Average energy J minimum
Austenitic						
304L	430	215	26	40	–196	41
304	480	220				
316L	430	215	26	40	–196	41
316	480	220				
317	480	240				
347	480	215	22	35	–196	41
Duplex						
UNS S 31803	600	420	20	35	0	41

Chapter 8
Aluminium Alloys

CORRIGENDUM

■ *Section 1*
Plates, bars and sections

1.10 Pressure weld tests

1.10.4 Where verification of fusion at pressure welds of closed profile extrusions is by drift expansion test, testing is to be generally in accordance with ~~4.3.4 and 4.3.5 and Fig. 2.4.1 in Chapter 2~~ Ch 2,4.3. The minimum included angle of the mandrel is to be 60°, and the minimum specimen length, 50 mm. For acceptance, there is to be no failure by a clean split along the weld line.

Chapter 11
Approval of Welding Consumables

Effective date 1 July 2009

■ *Section 2*
Mechanical testing procedures

2.1 Dimensions of test specimens

~~*2.1.1* Deposited metal tensile test specimens are to be machined to the dimensions shown in Fig. 11.2.1, and may be heated to a temperature not exceeding 250°C for a period not exceeding 16 hours for hydrogen removal, prior to testing.~~

~~*2.1.2* Butt weld tensile test specimens are to be machined to the dimensions shown in Fig. 11.2.2. The upper and lower surfaces of the weld are to be filed, ground or machined flush with the surface of the plate.~~

~~*2.1.3* Butt weld face and root bend test specimens are to be 30 mm in width and of the full plate thickness. Where the thickness exceeds 25 mm, two side bend test specimens may be tested in place of the face and root specimens specified. The side bend specimens should be 10 mm minimum thickness. The upper and lower surfaces of the weld are to be filed, ground or machined flush with the surface of the plate. The edges on the tension side are to be rounded to a radius of 1 to 2 mm. The highest convenient rate of bending (but not impact) should be used.~~

~~*2.1.4* All impact test specimens are to be of the standard 10 mm x 10 mm Charpy V-notch type, machined to the dimensions and tolerances detailed in Ch 2,3.~~

2.1.1 Dimensions of test pieces for deposited metal tensile tests, butt weld tensile tests, bend tests and Charpy V-notch impact test are to machined to the dimensions and tolerances detailed in Chapter 2.

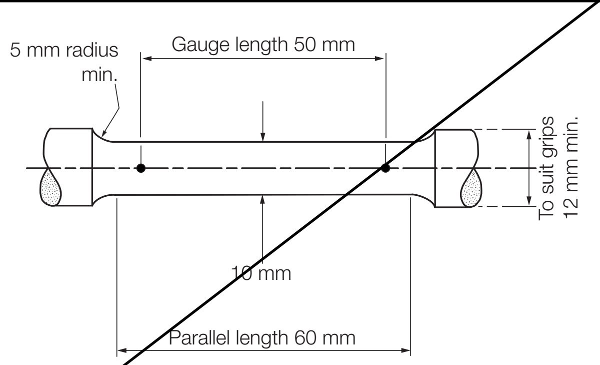
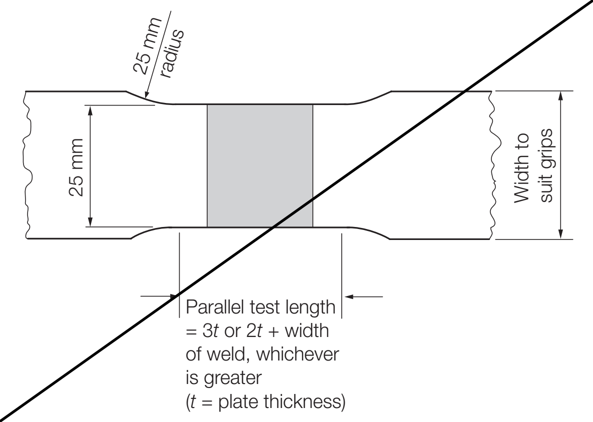


Fig. 11.2.1
Deposited metal tensile test specimen


25 mm radius
25 mm
Width to suit grips
Parallel test length = 3*t* or 2*t* + width of weld, whichever is greater (*t* = plate thickness)

~~**Fig. 11.2.2 Butt weld tensile test specimen**~~

2.3 ~~Re-test~~ Re-testing procedures

~~*2.3.1* Where the result of a tensile or bend test does not comply with the requirements, duplicate test specimens of the same type are to be prepared and satisfactorily tested. Where insufficient original welded assembly is available, a new assembly is to be prepared using welding consumables from the same batch. If the new assembly is made with the same procedure (particularly the same number of runs) as the original assembly, only the duplicate re-test specimens need be prepared and tested. Otherwise, all test specimens are to be prepared and tested as for the original assembly.~~

~~*2.3.2* Where the results from a set of three impact test specimens do not comply with the requirements, an additional set of three impact test specimens may be taken provided that not more than two individual values are less than the required average value and, of these, not more than one is less than 70 per cent of this average value. The results obtained are to be combined with the original results to form a new average (of six) which, for acceptance, is to be not less than the required average value. Additionally, for these combined results, not more than two individual values are to be less than the required average value and, of these, not more than one is to be less than 70 per cent of the average value. Further re-tests may be made at the Surveyor's discretion, in accordance with 2.3.1.~~

2.3.1 Re-testing procedures are to comply with Ch 2,1.4.

■ *Section 4*
Wire-flux combinations for submerged-arc automatic welding

4.1 General

4.1.6 For each strength level, wire-flux combinations which have satisfied the requirements for a higher toughness grade are considered as complying with the requirements for a lower grade.

■ *Section 5*
Wires and wire-gas combinations for manual, semi-automatic and automatic welding

5.2 Approval tests for manual and semi-automatic multi-run welding

5.2.1 Approval tests for manual (GTAW) and semi-automatic multi-run welding are to be carried out generally in accordance with the requirements of Section 3, except as required by 5.2, using the respective technique for the preparation of all test assemblies. ~~The results of the analysis are not to exceed the limit values specified in the standards or by the manufacturer, the narrower tolerances being applicable in each case.~~

■ *Section 8*
Consumables for welding austenitic and duplex stainless steels

8.5 Annual tests

8.5.1 Annual tests are to be carried out as required by the relevant Section appropriate to the type of consumable and welding technique. The tests are to include a weld ferrite content in accordance with 8.3.3.

Chapter 13

Requirements for Welded Construction

Effective date 1 July 2009

■ *Section 2* Specific requirements for ship hull and machinery

2.14 Welding afloat with water backing

2.14.1 Welding afloat with water backing is not recommended due to the additional precautions required during survey and therefore, is generally not permitted. However consideration may be given to welding afloat with water backing after specific LR approval has been obtained by the yard or fabricator prior to such welding being carried out. Such approval will only be given once all of the following conditions are satisfied:

(a) The welding procedure qualification tests are carried out on steel plates with water backing and the water is maintained at the flow rate and minimum water temperature anticipated during fabrication.

(b) The carbon equivalent of the steel plates used in the welding procedure qualification tests are to be greater than 0,41 per cent based on the IIW formula. Where it can be shown that all hull steel plates and new sections will have a carbon equivalent value below this figure, steel plates with the maximum carbon equivalent value may be used for the welding procedure qualification tests.

(c) Welding procedure qualification tests are carried out without preheat.

(d) The thickness of steel plate used in the welding procedure qualification test is the minimum hull plate thickness to be used during fabrication.

(e) The maximum measured hardness on the completed welding procedure qualification assembly is less than or equal to 350 HV10. Following fabrication welding, 10 per cent of welds are to be hardness tested in way of heat-affected zones at weld starts to confirm compliance with the 350 HV10 limit.

(f) The heat input used in the welding qualification test is the minimum permitted heat input during fabrication.

(g) Only low hydrogen welding consumables (H5) are used.

(h) In addition to normal non-destructive testing for welds, 10 per cent of the welds are additionally subject to magnetic particle inspection 48 hours after welding is complete.

(j) The welding procedure qualification tests for the repair of welds carried out afloat with water backing are to be carried out on test pieces that have previously been welded afloat and also meet the requirements above.

2.14.2 Welding in, or underwater, is not permitted.

Section numbering in brackets reflects any Section renumbering necessitated by any of the Notices that update the current version of the Rules for Materials.

Chapter 3

2.4.15	*Reference* Ch 2,3.2.3 *now reads* Ch 2,2.3.4.
3.6.9	*Reference* Ch 2,3.2.3 *now reads* Ch 2,2.3.4.
6.4.8	*Reference* Ch 2,3.2.3 *now reads* Ch 2,2.3.4.
7.4.4	*Reference* Ch 2,3.2.3 *now reads* Ch 2,2.3.4.
10.3.5	*Reference* Ch 2,3.2.3 *now reads* Ch 2,2.3.4.

Chapter 11

4.6.8	*Reference* Fig. 11.2.1 *now reads* Ch 11,2.1.1.

Chapter 12

2.7.2	*Reference* Fig. 11.2.1 *now reads* Ch 11,2.1.1.
2.7.4	*Reference* Fig. 11.2.1 *now reads* Ch 11,2.1.1.
2.13.2	*Reference* Ch 2,1.4.2 *now reads* Ch 2,1.4.4.

Chapter 13

4.8.3(a)	*Reference* Fig. 11.2.1 *now reads* Ch 11,2.1.1.
4.8.4(a)	*Reference* Fig. 11.2.2 *now reads* Ch 11,2.1.1.

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